State of California
Department of Food and Agriculture
Division of Measurement Standards

Certificate Number: 4110(c)-03

California Type Evaluation Program
Certificate of Approval
for Cryogenic Measuring Devices

For:

Hoffer ACEII
Liquid-Measuring Device Indicating Element
Models: ACE and ACEII

See Pages 2 and 3 for Specific Suffix Designations and Descriptions

Submitted by:

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Standard Features and Options

128x64 graphic display, LED backlight and adjustable contrast
Keypad, 3 soft keys + 2 scroll keys
Front panel infra-red transmitter/receiver for remote operation and communication
Heater option for front panel display
Calibration by flow meter 20-point linearization
Electronic temperature compensator
Pressure compensator
Optional scaled pulse output for remote electronic counter
Optional analog output, software configurable for function
Standard RS232 port for printer interface or Modbus communications
Pump Interlock Relay to disable pump during the occurrence of specific flow errors
NEMA 4X enclosure, optional explosion proof
Power supply: 8 – 30 Volts DC

This device was evaluated under the California Type Evaluation Program (CTEP) and was found to comply with the applicable technical requirements of California Code of Regulations for "Weighing and Measuring Devices." Evaluation results and device characteristics necessary for inspection and use in commerce are on the following pages.

Effective Date: May 22, 2003

Mike Cleary, Director

Hoffer Flow Controls, Inc.
Liquid-Measuring Device Indicating Element
Models: ACE and ACEII

Application: The cryogenic flow metering system may be used as a primary indicating element when metering cryogenic liquids, including hydrogen, or liquid carbon dioxide. The system is designed and approved to operate with turbine flow meters and similar approved and compatible devices equipped with magnetic signal generators.

Model Designation: ACE-X-X-X-X-X-X-X-X

Suffix Position Number	Suffix Number	Description
	Hardware	
1	A	Old style key format and 4-key explosion proof system
	B	New style key format (standard)
	Fluid	
2	0	LIN, LOX, LAR
	1	LH2
	2	CO2
	Software Application	
3	Version No.	Current version number assigned by manufacturer
	Software Version	
4	Revision No.	Current revision number assigned by manufacturer
	Language	
5	E	English
	Options	
6	X	None
	L	Low power supply
	H	High frequency cutoff (totalization stops @ 110% above high flow limit)
	Ticket	
7	A through Z	Various letter suffix represents a company ticket format
	Temperature and Pressure Reference Values	
8	2	USA: 70°F, 14.696 psia

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Model Designation: ACEII-X-X-X-X-X-X-X-X-X-X

Suffix Position Number	Suffix Number	Description
	Fluid/Product Options	
1	1	LIN/LOX/LAR
	2	CO2
	4	Liquid Hydrogen
	Temperature/Pressure Compensation Options	
2	T	Temperature Compensation
	P	Pressure Compensation
	TP	Temperature and Pressure Compensation
	Pump Interlock Option	
3	PI	Pump Interlock Option
	Analog Output Options	
4	7	4-20 mA Output
	8	1-5 V Output
	Scaled Pulse Output Options	
5	1	Open Collector
	2	TTL/CMOS
	Pulse Security Option	
6	PS	Quadrature input per ISO6551 Level B compliant. Requires dual coil on turbine.
	Power Input Options	
7	12	12 VDC Power Input
	24	24 VDC Power Input
	Heater Option	
8	H	Heater Option (required below 32° F)
	Enclosure Options	
9	S	Standard – flat mount with shocks
	T	Tilt bracket with shocks
	E	Explosion proof with 5 switches on cover
	Special Options	
10	SP	Any special features that are not covered in the model number. Use a written description of option.
	W	Windows based Configuration Program with Adapter and Cable

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Identification: The identification badge is located on the front or the side of the device housing.

Sealing: An audit trail records changes to calibration/configuration parameters. The audit trail records Time/Date/User ID/New Value/Old Value and is accessible as a hard printout by pressing PRINT and selecting Audit Trail. Two levels of password protection are provided, Supervisor and Operator. Each level allows up to 5 Pin numbers to identify specific users in audit trail records. Individual keys on the front panel may be disabled with a software lock provided in the Utility Functions menu.

Operation: The modes of operation for the ACEII are:

Operating: When power is first applied, ACEII will be functioning in the operating mode, displaying the Delivery Total. This mode is used to perform and display all flow computations of product delivery. Delivery totals may be cleared and tickets printed. A password is not required.

Configuration/Calibration: This mode is used to configure the system for all operational features and to enter all flow meter parameters. A password is required.

Diagnostics: This mode is used to verify functionality of the various input/output options for the ACEII. A password is not required.

Special Feature: When the ACE system is used in the measurement of liquid carbon dioxide, there are two additional modes added to the system. These modes are Single-Pipe and Dual-Pipe delivery modes. Only one of these two modes will be functioning at any given time. These features may be selected in the configuration mode and are password protected. When a vapor return line is used in the delivery, the Dual-Pipe selection is required. Dual-Pipe mode credits the buyer for carbon dioxide vapor recovered from their storage tank during filling.

Test Conditions: This Certificate supersedes Certificate of Approval Number 4110(b)-00 and is issued to include the Model ACEII indicating element, the audit trail method of sealing, improved electronic design incorporating 40MHZ CPU circuitry, and reprogrammable flash memory.

The Model ACE II-2T-P1-X-X-X-12-H-S-W was submitted for a laboratory evaluation to review design, operation, and audit trail requirements. After the laboratory evaluation, a field evaluation was conducted with the device installed on a vehicle dispensing liquid nitrogen. The emphasis of the field evaluation was on accuracy and repeatability. The device was configured to indicate in gallons using the conversion of 6.7381 lb/gal as compared to the cryogenic mass flow transfer standard. Three tests at three different flow rates ranging from 97 gal/min down to 39 gal/min were conducted. Vapor elimination tests were also conducted. The device was sealed and test repeated after approximately 45 days. Additionally, a device was tested while installed on a vehicle dispensing liquid carbon dioxide. The device was configured to indicate in pounds and three tests at three different flow rates ranging from 645 lb/min down to 350 lb/min were conducted. These tests were conducted with the device configured for the compensated (dual pipe) and uncompensated (single pipe) modes of delivery. The device was sealed and tests repeated after approximately 45 days. Previous test conditions are listed below for reference.

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Liquid-Measuring Device Indicating Element
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Test Conditions: (Continued)

Certificate of Approval Number 4110(b)-00: This certificate superseded Certificate of Approval Number 4110(a)-95 and was issued to recognize suffix changes on the ACE model identification badge. The issuance of this certificate is based on information provided by the manufacturer, and previous information and testing from Certificate of Approval Number 4110(a)-95. Changes made were non-metrological and included relocating sealing screws from the corner to the middle edges of the front panel and a DC power supply as an option.

Certificate of Approval Number 4110(a)-95: This certificate superseded Certificates of Approval Numbers 4110-94 and 3507-91 and was issued to consolidate liquid nitrogen with liquid hydrogen into this certificate. Additional testing was conducted to include liquid carbon dioxide. Tests, using liquid carbon dioxide, were conducted over a two month interval. The ACE system was interfaced with a Hoffer HO2x2-15-225-B-1-M-MS turbine meter and an RTD temperature probe (ModelPT1015-1000-2MSE). The liquid was metered from a loaded trailer on a scale and transferred to an empty trailer. The metered indications were compared with the scale net weight indications.

Certificate of Approval Number 4110-94: The ACE-LH-2 system was interfaced with a Hoffer HO4X2-40-120-B-1MX-V2 turbine meter and a Weed Instrument RTD temperature probe. Liquid hydrogen was metered from a loaded trailer on a scale and transferred to an empty trailer. The meter indications were compared to the net weights determined on a scale. Similar tests were repeated after two months and 145 000 gallons of throughput.

Certificate of Approval Number 3507-91: Tests, using liquid nitrogen, were conducted over a three month interval. The ACE system was interfaced with a Hoffer HO1-1/2x1-1/2-8-130B-1-M-MS turbine meter and a PT1015-1000-2-MSF temperature probe. The liquid was metered through the California cryogenic transfer standard and returned to storage. Thirty-five tests were performed at varying flow rates.

The results of these evaluations and information provided by the manufacturer indicate the devices comply with applicable requirements.

Type Evaluation Criteria Used: Title 4, California Code of Regulations, 2003 Edition

Tested By: Charles Nelson (CA), Norman Ingram (CA)